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ABSTRACT

The idea of learner control over instruction has enjoyed increasing popularity as a result of the growth of computer-assisted instruction in the schools. Some research results indicate that individuals learn more when given control over their instruction; other research indicates that individuals learn less effectively. This study investigates the effects of learner control and program control in full and lean computer-assisted instructional programs on the achievement of higher-ability and lower-ability university students. Subjects were 200 undergraduate education majors enrolled in their first semester of a professional teacher preparation program. The chapters from a required course textbook that were adapted into a computer-assisted program contained a total of 13 learning objectives. The program was developed in four versions that represent the four different treatment conditions (program-control lean and full and learner-control lean and full). Program control subjects were required to respond to all 174 screens in their version of the program; the full and lean versions varied in amount of practice-with-feedback screens (66 and 22, respectively). In the learner-control treatments, the learner began with practice-with feedback items for specific objectives. The lean version differed from the full in the manner in which students chose to add practice or move on to the next objective. A paper-and-pencil posttest covers the 13 objectives in the instructional program. A 13-item attitude questionnaire assesses subjects' satisfaction with the material, their perceived effort, desire for more information, continuing motivation and their confidence in their posttest performance. (Contains 25 references.) (AEF)

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Learner Ability and Learner Control in Computer Assisted Instructional Programs

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Introduction

The idea of learner control over instruction has enjoyed increasing popularity as a result of the growth of computer-assisted instruction in the schools. Several researchers have investigated the effects of allowing learners to choose the amount of practice, feedback, and review they desire as they progress through computer-assisted instructional programs (Carrier, Davidson, Williams, & Kalweit, 1986; Hicken, Sullivan, & Klein, 1992; Kinzie, Sullivan, & Berdel, 1988). Other researchers have allowed learners to choose the method of instructional delivery, such as lecture or group discussion (Pascal, 1971), or the size of the group in which they wish to work (Peterson & Janicki, 1979). Still others have explored learner control by matching student preferences for amount of instruction with the amount they receive (Freitag & Sullivan, 1994; Hannafin & Sullivan, in press).

Popular argument states that learner control is intrinsically appealing because it allows learners to tailor elements of instruction to their individual needs and preferences. Steinberg (1977) claimed that learner control can alleviate boredom, anxiety, and frustration, while maintaining learner attention and increasing motivation . Nevertheless, research has yielded inconsistent results regarding the benefits of learner control on learner achievement.

Some research results indicate that individuals learn more when given control over their instruction. Ross, Morrison, & O'Dell (1989) reported that higher posttest scores were obtained by undergraduate education majors who were allowed to select the instructional presentation medium than by students who were not. Kinzie, Sullivan, & Berdel (1988) found that eighth-grade science students given control over reviewing content scored higher on a posttest than students who were not given this option. Gray (1987) reported that college students having control over the sequencing of instructional content in an introductory sociology class scored higher on a retention measure than students without sequencing control. In Tennyson's research, twelfth-grade students enrolled in a psychology class benefited from controlling elements of their instruction, but only when informed about their own particular strategies for learning a task (Tennyson & Buttrey, 1980).

Other research indicates that individuals learn less effectively when given control over their instruction. Carrier et al. (1984) found that seventh-grade learners make poor instructional choices when encountering complex instructional material or lacking prior knowledge. Ross and Rakow (1981) reported that college students in an introductory sociology class who were given instructional control, but no guidance, also made poor instructional choices. Pollock and Sullivan (1990) found that seventh-grade science students receiving required practice items had higher posttest scores than students allowed control over the amount of practice they received.

Hicken et al. (1992), postulated that one reason for the mixed achievement results in studies of learner versus program control relates to the differing nature of the instructional programs and learner-control options in the studies. In some studies, learners have had the option to add instruction to a relatively "lean" instructional program that contains only a basic amount of instruction, thereby lengthening the program and providing themselves with more instruction. In such cases, learner control might be expected to be more effective than simply working through the basic lean program under program control. In other studies, learner control has involved the option for learners to bypass instruction in a relatively "full" instructional program that contains a more comprehensive amount of instruction and practice, thereby shortening the program and providing themselves with less instruction. In these cases, learner control may not increase the effectiveness of the full program and could conceivably decrease it. That is, learner control may have differential effects depending on whether exercising the control enables learners to lengthen a basic instructional program or to shorten a more complete one.

A series of studies (Hannafin & Sullivan, 1995; Hannafin and Sullivan, in press; Hicken et al., 1992; Igoe, 1993) has been conducted to investigate the effects of learner control in full and lean instructional programs. Collectively, these studies indicate that learner control over the amount of instruction in full and lean programs mitigates the achievement advantage that would normally be expected to favor the full program over the lean one. A significant achievement advantage for the full program over the lean one was obtained in only one of these four

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studies (Hannafin & Sullivan, 1995). Subjects under learner control in the full programs typically chose to bypass a relatively small amount of the instruction in their program version, while those in the lean programs normally chose to add less than half of the optional instruction available to them, thereby reducing the difference in the amount of instruction that would have been received by the full and lean groups under program control.

The option-selection pattern noted in the studies above involving learner control in both full and lean versions of an instructional program reflects a general tendency for learners to follow the default version of the program. That is, learners in a full version of a program tend to bypass a relatively low percentage of optional screens, and those in a lean version tend to add a relatively low percentage of optional screens. A similar pattern has also been observed by other researchers in studies including only a single learner-control option, to add instruction or to bypass it. Generally, learners who have an option to bypass instruction bypass only about 20 percent of the optional elements available to them (Pollock & Sullivan, 1990; Lopez & Harper, 1989; Hicken et al., 1992; Hannafin & Sullivan, 1995). Learners who have the option to add instruction typically select 30 to 40 percent of the additional available elements (Carrier & Williams, 1988; Carrier, Davidson, & Williams, 1985; Kinzie et al., 1988; Hannafin & Sullivan, in press). An exception to this latter pattern may occur in cases where learners are strongly motivated to do well, such as when the learner-controlled program consists of important course content that may have a significant influence on the subject's course grade. Igoe (1993) found that subjects in the lean version of an instructional program under such a condition chose to add 70 percent of the additional options available to them.

Learner time-in-program also varies across full and lean programs, sometimes in a way that is not consistent with the variation in the total number of screens viewed. Tennyson (1980) reported that subjects who received advisement in an instructional program spent more time and chose more options than subjects given control over the amount and sequence of elements in the program. Yet Kinzie and Sullivan (1989) and Kinzie, Sullivan, and Berdel (1988) found that learner-control subjects, despite bypassing review sections of an instructional program, spent a similar amount of overall time-in-program to subjects who were required to see the review. Interestingly, Schnackenberg, Sullivan, Leader, and Jones (1996) found that college students who used a full version of an instructional program, containing 242 screens with no learner-control option, did not spend significantly more time-in-program than subjects who used a lean version of the same program containing only 158 screens, presumably because the subjects in the lean program compensated for their fewer screens by spending more time per screen in the program. Hicken et al. (1992), also found that students in the lean version of their program spent significantly more time per screen in the program than those in the full version, suggesting that these students were compensating for the lesser amount of basic instruction.

Another factor that may influence the effectiveness of various versions of computer-assisted instructional programs is student ability. Ross and Rakow (1981), Tennyson and Rothen (1977), and Goetzfried and Hannafin (1985) found that lower-ability students benefit more from program control than from learner control. Hativa (1988) reported that lower-ability subjects spent less time-on-task in a learner-control treatment than higher-ability subjects. Hannafin and Sullivan (1995) found that higher-ability students in a learner-controlled lean treatment chose to add optional elements of the program in 43% of the cases, whereas lower-ability learners chose to add optional elements in only 19% of the cases. Thus, lower-ability students may choose to avail themselves of fewer options than higher-ability students in learner-control programs, and therefore they may not perform as well under learner control as under program control.

Although learner control studies have yielded mixed results on learner achievement, results related to student attitudes and motivation have been consistently favorable. Kinzie and Sullivan (1989) found that high school students in a learner-controlled treatment chose to return to that type of program more often than students in a program-controlled treatment. Morrison, Ross, and Baldwin (1992) reported that sixth-grade students allowed to choose the amount and context of practice problems had more positive attitudes than those who were not. Igoe (1993) found that college students given leanPlus and fullMinus versions of a learner-controlled program reported positive attitudes toward the learner-control feature in both versions.

The purpose of the present study is to investigate the effects of learner control and program control in full and lean computer-assisted instructional programs on the achievement of higher-ability and lower-ability university students. Four versions (program-control lean and full and learner-control lean and full) of a computer-assisted instructional program will be used as the instructional materials for the study. The program is designed in the Macintosh Hypercard format. Previous research (Igoe, 1993) indicates that subjects in the course involved in this study are strongly motivated to perform well in the instructional program and to receive a good grade.

The following research questions will be investigated:

1. Do university students achieve better under program control than under learner control in a computer-assisted instructional program?
2. Do students perform better in a full instructional program than in a lean one?
3. Does the availability of learner control affect student performance differentially in full and lean programs?
4. Do higher-ability and lower-ability students perform differently from one another under full and lean programs?
5. How does option use differ between higher-ability and lower-ability students under learner control in full and lean programs?

Questions related to learner attitudes and time-on-task under the different experimental treatments will also be investigated. Time on task will be examined with respect to total time by treatment, mean time per screen, and time per screen early and later the program.

Method

Subjects

Participants in the study will be approximately 200 undergraduate education majors enrolled in their first semester of a professional teacher preparation program. All participants will be registered for EDP 301, *Learning and Motivation*, during the Fall 1996 semester at Arizona State University.

Materials

The instructional materials are designed to teach content from a required textbook, Teaching for Competence (Sullivan and Higgins, 1983), for a course in which all students will be enrolled. Three chapters from the text (Worthwhile Objectives, Effective Instruction, Assessment) are adapted into a computer-assisted program in the Macintosh Hypercard format for the study. The three chapters contain a total of 13 learning objectives. Instructions for using the program are included as part of the introduction to the program.

The program is developed in four versions that represent the four different treatment conditions. The elements of instruction other than practice (information, examples, reviews, and summaries) are identical in all versions of the program. Each of the 13 objectives is taught through a number of screens which present the instruction, practice and feedback, summaries, and reviews. Nine objectives require selected responses in a multiple-choice format and four require constructed responses. Practice items consist of multiple-choice questions with two-to-four response choices for the nine selected-response objectives and of constructed-response items for the four constructed-response objectives. The program tracks each subject's progress by recording each response choice on a screen-by-screen basis.

Program-control subjects advance through the program by using a mouse and selecting a button titled "Continue" to go to the next screen. Subjects in the two program-control versions (lean and full) are required to respond to all screens in their version. The program-control full version contains 174 information screens and 66 practice-with-feedback screens (six multiple-choice practice items for each of the nine selected-response objectives and three constructed-response practice items for each of the four constructed-response objectives). The program-control lean version contains the same 174 information screens but only 22 practice-with-feedback screens (two multiple-choice practice items for the selected-response objectives and one constructed-response practice item for the constructed-response objectives). Thus, there are a total of 240 screens (174 information screens and 66 practice-with-feedback screens) in the full program-control version of the program and 196 screens (174 information screens and 22 practice-with-feedback screens) in the lean program-control version.

In the learner-control treatments, the first two practice-with-feedback items for "selected-response objectives" and the first one practice-with-feedback item for "constructed-response objectives" are part of the basic program. That is, all learners under both full and lean learner-control conditions complete these items. The remaining four practice-with-feedback items for each selected-response objective and two practice-with-feedback items for each constructed-response objective are optional items under control of the learner.

In the full version of the learner-control program, a learner begins the practice for an objective by completing the two basic practice-with-feedback items (one basic item for constructed-response objectives) for that objective. The learner then pushes the "Continue" button to forward the program to more practice-with-feedback items for the objective (two more items if it is selected response, one more if constructed) or the "No More Practice" button to bypass additional practice on the objective. If the learner chooses to continue at this first choice point, she/he is given the same option again ("Continue" or "No More Practice") after completing the item(s) from the

initial choice to continue. Thus, learners have a maximum of two choice points per objective, and at their option they may complete two, four, or six practice-with-feedback items for each selected-response objective or one, two, or three items per constructed-response objective.

The lean version of the learner-control program differs from the full one in the manner in which students choose to add practice or to move on to the next objective. As in the full program, a student begins practice-with-feedback for an objective by completing the two basic practice-with-feedback items (one for constructed-response objectives) for that objective. The student is then given the option of pushing the "Continue" button, which is essentially the default option in the lean program, or the "More Practice" button. The "Continue" button moves the student to the next objective without further practice-with-feedback on the current one, whereas the "More Practice" button provides two more practice-with-feedback items (one for constructed-response items) on the current objective. If a student selects the "More Practice" option at the first choice point, she/he is given the same option ("Continue" or "More Practice") again after completing the item(s) from the first choice. Thus, similar to subjects in the full version, learners in the lean one have a maximum of two choice points per objective, and at their option they may complete two, four, or six practice-with-feedback items for each selected-response objective or one, two, or three items per constructed-response objective. The difference is that in the full program the "Continue" choice moves the learner to additional practice-with-feedback items, whereas in the lean program the "Continue" choice moves the learner to the next objective.

Procedures

Prior to beginning the program, Scholastic Aptitude Test (SAT) or American College Testing Assessment (ACT) scores will be obtained for all subjects. A median score will be calculated for the overall sample. Subjects with scores at or below the median will be classified as lower-ability, and those with scores above the median will be designated as higher-ability. Subjects will then be randomly assigned to one of the four program versions within higher-ability and lower-ability groups.

Each subject will be given an individual program disk with his or her assigned version of the program. Instruction sheets with directions for using the available computer facilities on the university campus will be included with the disks. Subjects will be given a two-week period without class meetings to complete the program. At the end of this period they will report back to their regular class session. The experimenter, several teaching assistants, and the course instructor will be available to answer questions about the program.

A 52-item paper-and-pencil posttest, described in the criterion measures section, will be administered in the first class session after the two-week instructional period. Program disks will also be collected at this time.

Criterion Measures

The paper-and-pencil posttest will consist of 36 multiple-choice items and eight two-point constructed-response items covering the 13 objectives in the instructional program. The multiple-choice items will be scored either one or zero and the constructed-response items will be scored either two, one, or zero, according to a scoring key developed by the experimenter. Thus, the maximum possible score on the criterion test will be 52. The test items will be different items from the practice items, but will be in the same item form as the practice items for each objective.

A thirteen-item attitude questionnaire will assess subjects' satisfaction with the material, their perceived effort, their desire for more information, their continuing motivation and their confidence in their posttest performance. The attitude questionnaire, a five-choice Likert-type questionnaire, will be administered on-line immediately after students complete the instructional program.

Design and Data Analysis

The experimental design is a 2 (learner control mode) x 2 (full or lean program) x 2 (higher-ability vs. lower-ability) posttest-only design with random assignment of subjects to treatments within higher-ability and lower-ability groups. Analysis of variance (ANOVA) will be used to analyze the data for achievement and for time-in-program. Attitude questionnaire data will be analyzed using a multivariate analysis of variance (MANOVA), followed by a univariate analysis for each questionnaire item if the multivariate analysis indicates that it is appropriate. Option-use data will be analyzed using ANOVA.

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